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Mäki, Tarja Kaarina

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Multi-disciplinary discourse on design-related issues in construction site meetings

Tarja Mäki*

University of Helsinki, 00014 University of Helsinki, Finland

Abstract

Modern, complex construction projects require multi-disciplinary competence to ensure the quality of design. Site meetings are typically the arena in which designers, engineers and managers co-create and develop new design solutions, give feedback to each other and jointly discuss design-related issues. In these meetings, project partners transcend their traditional, distributed job descriptions in order to share their knowledge to create better design details. This study explores what design-related issues are addressed in the site meetings, who participates in the discussions and creates new design solutions, and with whose expertise the decisions on the new design solutions are finally made. The unit of analysis is a discussion episode, which encompasses actions from identifying a design-related topic to answering a question, solving a problem or making a decision on the topic. The research data were collected by observing actual site meetings in two renovation projects. The findings reveal that the site managers were the most active party addressing design-related issues in the meeting discussions. Their main reason for initiating a discussion in the meeting was the need to modify or specify an existing design detail. As design work is iterative by nature, the same design topics were discussed repeatedly in several meetings. Each party's – the project manager's, the designers', site managers' and others' – contribution was crucial in design-related issues, problem solving and the creation of new design solutions. However, the question remains whether this multi-disciplinary collaboration could be organized differently in order to avoid disturbances, delays, and extra work and costs from later design changes in construction projects.

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Keywords: construction; construction site meetings; cultural-historical activity theory; design; object of activity

1. Introduction

The importance of the design process and the collaboration between designers and site managers has been

* Corresponding author. Tel.:0358-40 755 2319.
E-mail address: tarja.maki@helsinki.fi

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recognized as a key factor in improving the quality of design and the productivity of construction. Currently, construction project collaboration has several challenges to overcome, and these challenges have serious effects on the costs and quality of the project. To develop design and construction collaboration in practice, it is crucial to understand the aims of the design and construction activities. However, the collaboration between the construction managers and designers is mainly studied by tracing patterns of interaction, levels of task-based or socio-emotional interactions, or communication networks. Little attention has been paid, for example, to the issues discussed in collaborative meetings or to how project partners participate in creating new design solutions, as well as to whose expertise is relied on for producing the new design solutions. Engeström (1999: 170) argues that *organizations may emerge through conversation, but they do not emerge for the sake of conversation.* In other words, from an activity-theoretical viewpoint, what is missing in previous studies is the object of discussion. This study focuses on site meeting discussions in two renovation projects in Finland. The aim is to reveal the content of the discussion, the topics discussed and the expertise of the different partners in making decisions or in creating new design solutions.

The paper contributes to knowledge on construction site meeting discussions and collaborative design work between site managers, designers and maintenance managers in the construction phase.

The paper proceeds so that the first section presents the theoretical framework of the study and the existing research on construction project meetings. Then the research site of the study is described, and the empirical data and the methods of the study are presented. The findings are presented in the following sections. Finally, the main findings are discussed in the context of the research literature, and the conclusions of the study are summarized.

2. Previous studies on construction project meetings

Alarcón and Mardones (1998) have analysed the problems associated with designs to be mainly 1) poor design quality, 2) a lack of design standards and 3) poor constructability. The inability to utilize acquired experiences from previous projects in new ones has been found to be one potential source of low quality and higher construction costs (Gerth, Boqvist, Bjelkemyr & Lindberg 2013: 135). In contrast, the early involvement of contractors in a design process has proved to lessen constructability problems, lower project costs and result in faster completion rates during the construction phase (Trigunarsyah 2007: 215).

In recent years, several academic studies have focused on defining communication behaviour, interaction and coordination in construction project meetings (Foley & MacMillan 2005; Boudeau 2013; Gorse & Emmitt 2007, Gorse & Emmitt 2009), and on clarifying what issues affect the willingness of representatives of different parties to share knowledge (Ankrah & Langford 2005: 602; Ding, Ng & Cai 2007). According to these studies, meeting discussions appear to be highly task based and seem mostly to take place between a project manager, a contractor and an architect (Gorse & Emmitt 2007; Gorse & Emmitt 2009; Foley & MacMillan 2005). Knowledge sharing and partnering in the construction field are potential new collaborative working practices (Hartmann & Bresnen 2011), but are difficult to integrate into construction field practices because of the current hostile and litigious collaboration environment in the field (Bishop, Felstead, Fuller, Jewson, Unwin & Kakavelakis 2009).

Dossick and Neff (2011: 83) have found BIM to be an efficient tool for the information exchange of explicit knowledge. However, messy talk and informal, active and flexible conversations are still needed to exchange tacit knowledge in inter-organizational collaboration among architects, designers and construction professionals in building projects. The talk and informal conversations take place in project meetings. They bring up critical issues that require face-to-face discussion and co-design work. The aim of the meetings is to provide an arena for these discussions and through this arena to proceed with the project.

Cultural historical activity theoretical (CHAT) has much to add to the research on construction meetings and collaboration practices. CHAT as a methodology emphasizes an object of activity as the enduring, constantly reproduced purpose of a collective activity system (Engeström 1995). The object is simultaneously "an independently existing, recalcitrant, material reality and a goal or purpose or idea that we have in mind" (Adler 2005: 404). The object motivates and defines the goals and actions, while the goals are relatively short-lived and finite aims of individual actions. Meeting discussions are not "pure talk" situations or off-line conversations, and they cannot be separated from practical activity. Instead, each organizational partner who participates in the meeting discussion advances his or her own purposes or goals for his or her actions, and through that, the object of his or her activity.

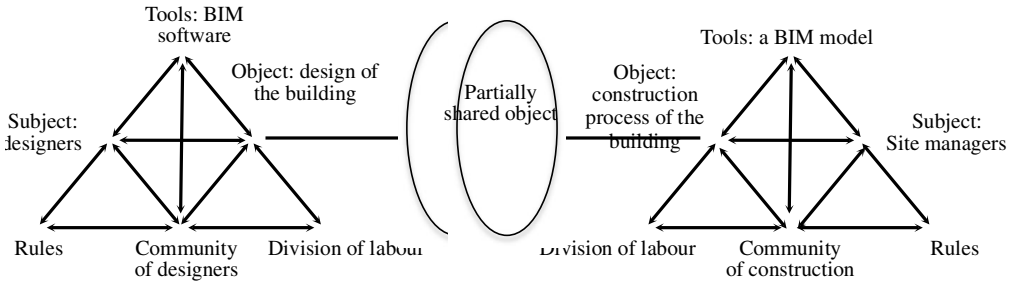

Fig 1. Partially shared object of two activity systems of design and construction. The designers' activity aims to design the building and produce BIM models of the building. The design activity is mediated by BIM software tools. The managers' activity aims to plan the construction work in the actual building. The work is mediated by the BIM models (modified from Engeström et al. 2010).

The object of an architect's activity system is the whole architectural design of the building and the various digital and material representations of its design. In reality, the object of design activity is formed from several separated but interconnected design solutions. Through the activity theoretical lens, these solutions can be examined as the goals of actions. Correspondingly, the object of a site manager's activity system is to plan and manage the construction of the building. This object can also be divided into separate goals, such as building parts or construction tasks. Both of these goals, or sub-objects, are discussed in site meetings from the point of view of different project partners.

In this case, the objects of activities are analysed through design issues, which require multi-professional discussion and common decision making during the construction phase. Although the objects, or sub-objects, of the designers' and site managers' activity are different, they are partly shared and intertwined in meeting discussions. Contrary to the traditional division of labour, the site managers contribute to the design work of the building. They construct a partially shared object with designers and act together to advance the object of producing the design solutions for the building (see Fig. 1). As the objects are still only partially shared, tensions are occasionally expressed (Engeström & Sannino 2010).

This study is based on the tradition of Cultural Historical Activity Theory. The concept of the object of activity has been used as a methodological concept to guide the analysis. The analysis focuses on the topics of the meeting discussions and the participation of different project partners in the site meetings.

The research questions of this study are:

1) What design-related issues do the different partners address in the meetings?
2) Who participates in the discussions and the creation of new design solutions?
3) With whose expertise are the new design solutions created?

3. Research methods and data of the study

The ethnographic method of the study is observation. Observing the project personnel in their natural work situations is needed to discover the actual collaboration and discussions held in everyday site meetings. This follows the insight of the ethnography of the traditions of design engineering: interviews and surveys are insufficient for uncovering problems or challenges or the emerging collaboration between the partners (Buchiarelli 1988, Henderson 1999, Miettinen et al. 2012). The researcher attended the meetings and site tours, wrote field notes on the discussions, took photographs during the site tours, and audio- and video-recorded the meetings, but did not interfere with any actions. The audio- and video-recorded observation data were transcribed verbatim and divided into speech turns. Every speaker's utterance that can be heard on the recordings was counted as a speech turn.

The cases of the study consist of two construction projects in central Finland. Both were school renovation projects and were part of a larger life-cycle project that included four schools and one day-care centre. The design offices and construction companies were the same for all the projects. The complexity, the size and the timeframe of the projects and the involvement of the site managers were equal in both projects. Due to certain challenges in the first project, the project manager made some changes in the design management practices of the second project. These changes had some effects on the design work.

Site meetings were selected as cases for this study because they provided an important and regular event for examining the managers', designers' and supervisor's collaborative design work. The site managers were active in giving feedback to the designers: for each site meeting they had made a list of current design flaws or missing information needed from the designers for their work. But they were also active in negotiating and producing novel design solutions for the buildings.

The site meetings were organized in the same manner in both projects. They were a direct continuation of the design meetings. The design meetings were organized once a month from the beginning of the design phase until the start of construction work. These meetings were assembled and chaired by the project manager as a representative of the developer. The meetings were arranged in the developer's office until the construction phase started, and then the site meetings were organized at the site offices. The site managers also attended the site meetings along with the designers, the supervisors, the maintenance manager and other invited partners. Typically, the participants of a site meeting took a site tour before each meeting. During the tour, the status of the construction work and possible design-related issues were viewed so that they could be addressed in the meeting. Some solutions were created already during the site tour, but typically they were also discussed in the meeting.

The agenda of the construction site meetings was as follows: 1) Opening of the meeting (chairman, secretary); 2) Approval of the meeting agenda; 3) The previous meeting's proceedings; 4) Official matters; 5) Construction work and work force status; 6) Schedule of the project; 7) Procurements; 8) Work safety and environmental matters; 9) Financial matters, additional and modification tasks; 10) Chief contractor's matters; 11) HVAC-E contractor's matters; 12) The status of the design work, the architect's matters, structural engineering matters and HVAC-E engineering matters; 13) The developer's matters; 14) Risks in the project; 15) Other matters; 16) Scheduling of the next meeting.

The meetings were often three to four hours long because many items were on the agenda and the participants would engage in active discussion. To save time, items 1, 2, 9 and 14 were usually skipped. Most of the time was spent discussing items 10–13 so that each party was able to raise design-related issues that required discussion.

The data analysed for this paper are a part of a larger corpus of ethnographic data: interviews of site managers, shadowing data of the construction site managers' daily work at several construction sites, observations of the site meetings in two construction projects for two years, meeting memos of site meetings and photographs of site tours.

Table 1. Site meetings of construction project 1 between August 2011 and April 2012.

Date of site meeting	Duration	Number of participants	Number of discussions	Analysed speech turns
22 Sept 2011	218 min	15	46	919
19 Oct 2011	175 min	14	47	607
17 Nov 2011	153 min	13	30	509
13 Dec 2011	79 min	13	17	219
11 Jan 2012	90 min	11	19	310
14 Feb 2012	64 min	12	22	359
20 Mar 2012	90 min	9	23	463
24 Apr 2012	108 min	14	20	298
Not recorded	–	–	–	–
Σ	14 :47		224	3684

The site meetings in the two construction projects generated approximately 30 hours of audio- and video-recorded observation data, in which 411 design-related issues were discussed. The data are presented in more detail in Tables 1 and 2. The duration, number of participants, number of discussions and analysed speech turns are presented to present a more comprehensive understanding of the meetings.

Table 2. Site meetings of construction project 2 between August 2012 and May 2013.

Date of site meeting	Duration	Number of participants	Number of discussions	Analysed speech turns
20 Aug 2012	129 min	14	26	425
17 Sept 2012	149 min	12	27	553
25 Oct 2012	142 min	11	33	748
Not recorded	–	–	–	–
19 Dec 2012	99 min	12	14	450
24 Jan 2013	101 min	10	16	467
21 Feb 2013	78 min	9	18	383
19 Mar 2013	101 min	11	23	454
23 Apr 2013	128 min	11	22	358
14 May 2013	83 min	10	8	91
Σ	14 :28		187	3956

Each party raised design-related topics, problems or open questions in the site meeting discussions. The topics (see Table 3) are considered the goals of the actions, or the sub-objects, of each party. The unit of analysis used is a discussion episode, which encompasses identifying a design-related issue, having a discussion, asking and answering questions, and creating new design solutions or making other decisions.

4. Findings

4.1. What design-related issues were addressed in the meetings?

The most frequent topics addressed in the site meeting discussions were issues related to the design for landscaping and the grounds surrounding the building, building service technology, wall structures, furnishings and equipment, windows and doors, and the gymnasium. A considerable amount of discussion was on common procedures in relation to modelling or updating the models. In addition, roofs, electrical installation and ducts raised many questions and generated discussion. Other topics that generated recurring discussion involved floor structures, ceilings and staircases and the related equipment. Further, the designs of the mechanical room and the kitchen were often discussed.

Discussion on the design for landscaping and the grounds surrounding the building took place in 15 meetings. The highest number of discussions on landscaping in one meeting was seven. The site managers (40) and the project manager (4) in particular raised the discussions related to landscaping. Either the lack of designs for landscaping (20) or the need to change or complement an existing design (20) functioned as the motive for opening a discussion on the topic. The actual discussion topics were underground structures, equipment, surfaces and storage houses in the yard. Some of the topics were discussed repetitively as the project proceeded.

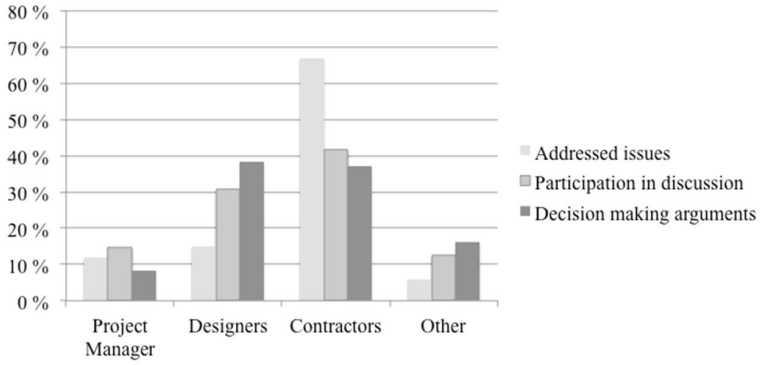

Fig 2. Addressed design-related issues, participation in the design-related discussions and on whose arguments the design solutions were based on in the site meetings. The group called 'Other' represents mainly the supervisor and maintenance manager.

As Figure 2 illustrates, the site managers were in general the most active in raising design-related issues. They raised close to 70% of all the issues. The site manager had created a list of design flaws and missing information for each meeting. He had used the traffic light colours red, yellow and green to depict the urgency of each design-related problem, for example, a missing design solution, on the list. The list functioned as a means of transferring information from the site managers to the designers.

When examining the reasons for initiating discussions in the meetings (see Table 3), most typically an already drawn-up detail in the design needed to be changed or specified. Often, a design was late, so the designers were asked to produce the design by a specific date. At times the design document existed, but it was lacking a design detail needed in the construction work. Site managers also made design suggestions of their own to replace the ones created by the designers, and these suggestions were almost invariably approved in the discussions.

The discussion initiated by the designers typically aimed at clarifying the initial information required for the design. Generally, a discussion initiated by the project manager aimed at either checking whether a certain design-related task had been taken care of or discussing the procedures in general.

In addition to these, design-related procedures were largely discussed; the designers were asked to update the existing designs, for example, for inspection by the building regulations authority; or the designers were informed of a deviation in implementing a design, and its effects on the progress of the project were discussed.

Table 3. Reasons for initiating a discussion in the site meetings.

Reason for initiating a discussion	Number of discussions
A design document does not exist.	57
A design document exists, but lacks a needed design solution.	40
An existing design solution requires modification or specification.	180
A new suggestion for a design solution is made by a site manager.	18
A site manager indicates an execution divergent from a design document.	6
A design document needs to be updated.	16
Common procedures need to be discussed.	17
Other	38

4.2. Discussing and creating new design solutions in the site meetings

To answer the second and the third research questions, this section shortly describes which parties participated in the discussion and creation of new design solutions and with whose expertise the new design solutions were created.

Although the site managers mainly took the initiative in generating discussion and were active discussion partners, other parties were also actively involved in the discussions (see Fig. 2). The main discussion partners were the site managers, the designers and the project manager. Depending on the topic of discussion, the life-cycle and maintenance managers and supervisors (the group 'Other') also actively took part in the discussion.

When examining by whose expertise the new design solutions were created or the existing ones modified, the designers' contribution exceeded that of the other parties (see Fig. 2). Yet the expertise of the site managers became almost as relied upon concerning new design solutions. The importance of the group 'Other' also became relatively larger in this respect.

The creation of new design solutions proceeded in different ways in different discussions. In some, a solution was created that relied on the expertise of one party with no opposing suggestions. In another, each party supplemented the created design solution with their expertise, in which cases the discussion bore a similarity to putting together the pieces of a mosaic. At times, discussion emerged in which the views of the different parties were in opposition.

5. Discussion and conclusion

The collaboration of project manager, designers, site managers and maintenance managers seems crucial for ensuring the quality of design in construction projects. In the analysed site meeting data, 411 design-related issues were initiated for discussion, mostly by the site managers. However, these initiated issues were only the tip of the iceberg of the design-related issues requiring common discussion. A number of other issues were discussed and solved outside of these meetings. The findings confirm those of Alarcon and Mardones (1998) regarding incomplete design drawings and the requirement for a great amount of specification in the construction phase.

In the study presented here, the existing design solutions were developed and new ones created in the site meetings through the collaborative contribution of all of the parties in the project, which emphasizes both the need and the potential for collaborative effort and knowledge sharing to advance the project, despite the different partners only partially sharing their objects of activity. The results of this study are like a double-edged sword: on one hand, it is highly promising that the project partners have such a dynamic collaboration and that they aim to solve the design-related problems in the site meetings in a collaborative manner. At the same time, the question arises whether these problems could have been discussed and solved earlier in the project, instead of waiting until the construction phase (Trigunarsyah 2007). While Gerth and his colleagues (2013) argue that experiences from previous projects can be a potential resource to improve quality and lower construction costs, further questions arise: when, how and by whom should design collaboration be organized to ensure that different forms of expertise are fully utilized in the project?

Unlike Bishop and his colleagues (2009), who described the British construction environment as hostile and litigious, the site meetings in this data were held in a highly collaborative atmosphere. No blaming or threats were observed, even when the project had a severe shortage of time and money. In fact, the head of the main contractor emphasized that pointing fingers is useless; instead, solutions to the problem should be decided mutually. However, collaborative design work between designers and site managers is not self-evident. It requires crossing the borders of the traditional division of labour. When site managers contribute to design work, their object of activity expands and becomes partially shared with designers. The emerging design-related meeting practices challenge the current assumptions of the roles and the division of labour of the project partners. The need clearly exists for research on and the creation of new co-design practices for construction projects as well as the re-examination of current knowledge-sharing practices between site managers, designers, material suppliers, maintenance managers and end users to better support the quality of design work.

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